

WHAT IS CLAIMED IS:

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1. A display device comprising  
a plurality of charged substances in different charged states or with  
5 opposite polarities in two regions of a surface area of a base material,  
wherein an organic film is bonded and fixed to a part of or an entire  
surface of the base material having a volume of less than  $1\text{ cm}^3$  via  $\text{-A-O-}$   
bond, where A denotes Si, Ge, Sn, Ti or Zr, or via  $\text{-A-N-}$  bond, where A  
denotes Si, Ge, Sn, Ti or Zr; the surface region of the base material is divided  
10 into two regions in accordance with the kind of organic films or the presence  
or absence of the organic film; and each of the two regions accounts for 40% or  
more and 60% or less of the surface area of the base material; and  
wherein the plurality of charged substances are dipped in liquid  
between a pair of substrates each having an electrode, and voltage is applied  
15 to the electrodes, thereby enabling the charged substances to be rotated.
2. The display device according to claim 1, wherein at least one of the  
substrates is equipped with a color filter.
- 20 3. The display device according to claim 1, wherein the organic film is a  
monomolecular film.
4. The display device according to claim 1, wherein the film thickness of  
the organic film is 100 nm or less.
- 25 5. The display device according to claim 1, wherein the base material of  
the charged substance has a sphere shape.
6. The display device according to claim 1, wherein the base material of  
30 the charged substance has a cylinder shape.
7. The display device according to claim 1, wherein the liquid has a high  
resistance of  $10^4\ \Omega\text{cm}$  or more.
- 35 8. The display device according to claim 7, wherein the organic film  
comprises adsorbed water and is in contact with the high resistance liquid.

9. The display device according to claim 7, wherein the organic film adsorbs water containing electrolytes and is in contact with the high resistance liquid.

5 10. The display device according to claim 7, wherein the organic film adsorbs water by a surfactant.

11. The display device according to claim 10, wherein the surfactant has both a cationic property and an anionic property.

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12. The display device according to claim 1, wherein the difference between the refractive index of the transparent substrate located in a light path where light enters, passes through and is reflected from and the refractive index of the liquid is 0.1 or less.

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13. The display device according to claim 1, wherein the film thickness of the electrode has an odd multiple of one-half the light wavelength.

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14. The display device according to claim 1, wherein each of the charged substances functions as a pixel and each pixel is provided with at least one lens.

15. The display device according to claim 1, wherein the lens is provided on the substrate located at the side of a viewer.

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16. A method for manufacturing a display device, using charged substances having a volume of less than  $1\text{ cm}^3$  in different charged states or with opposite polarities in two regions of a surface area of a base material, wherein an organic film is bonded and fixed to a part of or an entire surface of the base material via  $\text{-A-O-}$  bond, where A denotes Si, Ge, Sn, Ti or Zr, or via  $\text{-A-N-}$  bond, where A denotes Si, Ge, Sn, Ti or Zr; the surface region of the base material is divided into two regions in accordance with the kind of organic films or the presence or absence of the organic film, and each of the two regions accounts for 40% or more and 60% or less of the surface area of the base material,

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the method comprising:

forming one or more of concave portions for disposing one or more of

the charged substances in predetermined positions of an insulating substrate disposed between the electrodes;

5 making the surface of the concave portions to be hydrophilic, the surface of the substrate other than the concave portions to be water-repellent and the surface of the charged substances to be hydrophilic; and

disposing the charged substances in the concave portions by pouring a liquid containing the charged substances from one side to another of the substrate.

10 17. A method for manufacturing a display device, using charged substances having a volume of less than  $1\text{ cm}^3$  in different charged states or with opposite polarities in two regions of a surface area of a base material, wherein an organic film is bonded and fixed to a part of or an entire surface of the base material via  $\text{-A-O-}$  bond, where A denotes Si, Ge, Sn, Ti or Zr, or via  
15  $\text{-A-N-}$  bond, where A denotes Si, Ge, Sn, Ti or Zr, in the former, the side of O is bonded to the substrate and in the latter, the side of N is bonded to the substrate; the surface region of the base material is divided into two regions in accordance with the kind of organic films or the presence or absence of the organic film, and each of the two regions accounts for 40% or more and 60% or  
20 less of the surface area of the base material,

the method comprising:

forming one or more of concave portions for disposing one or more of the charged substances in predetermined positions of an insulating substrate disposed between the electrodes;

25 making the surface of the concave portions to be hydrophilic, the surface of the substrate other than the concave portions to be water-repellent and the surface of the charged substances to be hydrophilic; and

by pouring only liquid from one side to another of the substrate, thereby allowing the liquid to remain only in the concave portions, and then  
30 pouring the charged substances from one side to another of the substrate, thereby disposing the charged substances in the concave portions.

18. A method for manufacturing a display device, using charged substances having a volume of less than  $1\text{ cm}^3$  in different charged states or  
35 with opposite polarities in two regions of a surface area of a base material, wherein an organic film is bonded and fixed to a part of or an entire surface of the base material via  $\text{-A-O-}$  bond, where A denotes Si, Ge, Sn, Ti or Zr, or via

-A-N- bond, where A denotes Si, Ge, Sn, Ti or Zr, in the former, the side of O is bonded to the substrate and in the latter, the side of N is bonded to the substrate; the surface region of the base material is divided into two regions in accordance with the kind of organic films or the presence or absence of the organic film, and each of the two regions accounts for 40% or more and 60% or less of the surface area of the base material;

the method comprising:

forming concave portions for containing the charged substances arranged in rows and columns on the glass substrate, exposing the glass surface on the concave portion and coating the portion other than the glass surface with a water-repellent organic film;

on three masks corresponding to each color of red, green or blue and having grooves on the portions corresponding to the arrangement of colors, coating the portion other than the groove containing the charged substances with a water-repellent organic film and coating the wall surface of the groove with a hydrophilic organic film;

causing liquid to flow from one side to another of one mask selected from the three masks, thereby allowing the liquid to remain in the grooves;

spraying the charged substances to the selected mask to allow the charged substances to be taken into the liquid;

approaching the glass substrate in which the liquid is allowed to remain in the concave portion to the groove provided on the selected mask, thereby fusing the liquid on the selected mask and the liquid on the glass substrate;

allowing the charged substances to be contained in the concave portions of the glass substrate; and

repeating the same processes with respect to the other masks, thereby arranging the charged substances corresponding to each color.

19. The method for manufacturing a display device according to claim 18, wherein in fusing the liquid on the selected mask and the liquid on the glass substrate;

the dry air is blown from one side of the selected mask or the selected mask is irradiated with a heat ray to evaporate the liquid remaining in the grooves of the selected mask.

20. The method for manufacturing a display device according to claim 18,

wherein in fusing the liquid on the selected mask and the liquid on the glass substrate;

pressure of the dry air sent from one side of the selected mask is applied to fuse the liquid on the selected mask and the liquid on the glass substrate.

21. The method for manufacturing a display device according to claim 18, wherein the three masks have convex portions corresponding to the concave portions for containing the charged substances in the glass substrate.

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22. The method for manufacturing a display device according to claim 16 or 18, wherein the static contact angle with respect to pure water on the water-repellent surface is 90 degrees or more and the static contact angle with respect to pure water on the hydrophilic surface is less than 90 degrees.

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23. The method for manufacturing a display device according to claim 16 or 18, wherein the static contact angle of the liquid used for pouring the charged substances is 60 degrees or more on the water-repellent surface and 50 degrees or less on the hydrophilic surface.

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24. The method for manufacturing a display device according to claim 16 or 18, wherein the liquid in which the charged substance is dipped or the liquid to be retained in the concave portion has a boiling point of 70 °C or more and less than 100°C.

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25. A method for manufacturing a display device, using charged substances having a volume of less than 1 cm<sup>3</sup> in different charged states or with opposite polarities in two regions of a surface area of a base material, wherein an organic film is bonded and fixed to a part of or an entire surface of the base material via -A-O- bond, where A denotes Si, Ge, Sn, Ti or Zr, or via -A-N- bond, where A denotes Si, Ge, Sn, Ti or Zr, in the former, the side of O is bonded to the substrate and in the latter, the side of N is bonded to the substrate; the surface region of the base material is divided into two regions in accordance with the kind of organic films or the presence or absence of the organic film, and each of the two regions accounts for 40% or more and 60% or less of the surface area of the base material;

the method comprising:

forming one or more of concave portions used for disposing the charged substances in the insulating substrate;  
disposing the electrode so as to be in proximity to the concave portion;  
and

5       pouring a liquid containing the charged substances to the concave portions in a state in which AC electric field is applied by the use of the electrode, thereby disposing the charged substances in the convex portions.

26.     A method for manufacturing a display device: using charged  
10     substances having a volume of less than  $1\text{ cm}^3$  in different charged states or with opposite polarities in two regions of a surface area of a base material, wherein an organic film is bonded and fixed to a part of or an entire surface of the base material via  $\text{--A--O--}$  bond, where A denotes Si, Ge, Sn, Ti or Zr, or via  $\text{--A--N--}$  bond, where A denotes Si, Ge, Sn, Ti or Zr in the former, the side of O is  
15     bonded to the substrate and in the latter, the side of N is bonded to the substrate; the surface region of the base material is divided into two regions in accordance with the kind of organic films or the presence or absence of the organic film, and each of the two regions accounts for 40% or more and 60% or less of the surface area of the base material,

20       the method comprising:

      filling the charged substances in a nozzle and mixing the charged substances and a paste in the vicinity of an outlet port for ejecting the discharged substances from the nozzle, and arranging the charged substrate in rows and columns on the substrate.

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27.     A method for manufacturing a display device, comprising:

      coloring a half part of a fiber whose cross sectional shape is circular;

      forming an organic film bonded and fixed to the surface of the fiber via  $\text{--A--O--}$  bond, where A denotes Si, Ge, Sn, Ti or Zr, or via  $\text{--A--N--}$  bond, where A  
30     denotes Si, Ge, Sn, Ti or Zr;

      forming a sacrificial film on the organic film;

      arranging both a fiber provided with the sacrificial film and a transparent filler on a substrate at predetermined intervals;

      solidifying the filler;

35     cutting the arranged film into a predetermined length; and

      removing the sacrificial film;

      wherein the surface region of the fiber, which is cut into a

predetermined length in accordance with the kind of organic films or the presence or absence of the organic film; each of the two regions accounts for 40% or more and 60% or less with respect to the total surface area of the fiber cut into the predetermined length; and the two regions are in different charged states or have different polarities.

28. A method for manufacturing the display device, comprising:  
disposing a fiber having a circular cross section and provided with an organic film bonded and fixed to a surface thereof via -A-O- bond, where A denotes Si, Ge, Sn, Ti or Zr, or via -A-N- bond, where A denotes Si, Ge, Sn, Ti or Zr and on the substrate together with a filler at predetermined intervals;  
solidifying the filler;  
polishing or grinding the fiber to form into a half-cylinder shaped fiber;  
forming a white film on the surface of the half-cylinder shaped fiber;  
forming a film colored with any one of colors selected from cyan, magenta, and yellow on the surface of the white film;  
laminating a transparent film having a predetermined thickness on the surface of the half-cylinder surface;  
heating the transparent film to cause it to take a semicircular shape and thereby form a cylinder-shaped fiber; and  
cutting the cylinder-shaped fiber into a predetermined length.

29. A method for manufacturing a display device, comprising:  
forming a multilayer film by sequentially adhering a first transparent film, a second film having a front surface of any one color from cyan, magenta, and yellow, and a rear surface of white, and a third transparent film having the same thickness as the first film;  
drawing a fiber that is cut so as to have a quadrangle cross section from the heated nozzle, molding the cross sectional shape to be circular, and further forming an organic film bonded and fixed to the surface of the fiber via -A-O- bond, where A denotes Si, Ge, Sn, Ti or Zr, or via -A-N- bond, where A denotes Si, Ge, Sn, Ti or Zr, on the surface;  
forming a sacrificial film on the organic film,  
disposing the fiber in a state in which the sacrificial film is formed on the substrate with a transparent filler at predetermined intervals,  
solidifying the filler;

cutting the fiber in a predetermined length; and  
removing the sacrificial film.

add a 27

1. The first step is to cut the fiber in a predetermined length; and  
2. The second step is to remove the sacrificial film.  
3. The third step is to cut the fiber in a predetermined length; and  
4. The fourth step is to remove the sacrificial film.  
5. The fifth step is to cut the fiber in a predetermined length; and  
6. The sixth step is to remove the sacrificial film.  
7. The seventh step is to cut the fiber in a predetermined length; and  
8. The eighth step is to remove the sacrificial film.  
9. The ninth step is to cut the fiber in a predetermined length; and  
10. The tenth step is to remove the sacrificial film.